**Lab #38: Oxidation-Reduction Reactions of Metals and Metal Ions (Investigation 15C)**

*Materials*

* 1 strip (10cm) of each: Cu, Zn, Ag, Fe and Sn
* 1 dropper bottle of 0.10M of each: Cu(NO3)2, Zn(NO3)2, AgNO3, Fe(NO3)2 and Sn(NO3)2
* Steel Wool
* Distilled Water
* Waste Disposal for heavy metals

**Pre Lab \*Annotate the following information\***

The usefulness of metals in structural and other applications depends on their physical and chemical properties. Although iron is the most common metal used in manufacturing, it must be protected against corrosion because iron rusts easily. Copper is used in electrical wiring because it conducts electricity extremely well and resists corrosion better than many metals. Gold is a highly valuable jewelry metal because it is essentially unreactive. In this investigation you will set up an *activity series* for some metals. An activity series arranges metals according to their ability to be oxidized. As you will see, some metals lose electrons more easily than others.

**Part 1: Procedure**

|  |  |  |
| --- | --- | --- |
| Metal | Color | Malleability |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

1. Use steel wool to clean off one side of each of your metal strips.
2. Make some observations about your metal strips. Not the color, malleability. It is important that you can distinguish which metal is which. It is a good idea to label them with tape and a marker because some of them may look similar to you.
3. On each strip place one drop of each of the aqueous metal ion solutions using the dropper bottles. Test only one solution at a time so that you do not get confused about which solution is causing the reaction. Once the drop is placed on the metal strip it may take a minute or so for the reaction to occur. However, no more than a couple of minutes are needed. In most cases the reaction will occur right away.
4. As you perform your tests fill in the data table below. Write “RXN” if a reaction occurred or “NR” if no reaction occurred.
5. Rinse off each of the metal strips with tap water and dry them with a paper towel. Return them to the appropriately labeled location.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Ions | | | | |
| Metals | AgNO3 | Zn(NO3)2 | Cu(NO3)2 | Fe(NO3)2 | Sn(NO3)2 |
| Zn |  |  |  |  |  |
| Cu |  |  |  |  |  |
| Fe |  |  |  |  |  |
| Sn |  |  |  |  |  |

**Part 3: Activity Series**

1. Make a list that organizes the metal strips you tested. Arrange them from ***most*** easily oxidized to least easily oxidized.

**Part 4: What did you learn?**

1. How do you think an activity series would be helpful to a chemist?
2. Give a practical example of a metal oxidizing in your everyday life.

**Part 5: Writing the chemical equations**

We will write out reactions for the tests that caused a reaction. It is not necessary to do the combinations that did not result in an obvious reaction.

**Steps 1-3 have been done for you and are provided in the table below:**

1. Referring to your data table above, write down the reactant solutions for one reaction

*Example: Zn(s) + Cu(NO3)2(aq) →*

1. Separate the reactant ions in the aqueous solution.

Example: Zn(s) + Cu2+(aq) + 2NO3-(aq) →

1. This is an example of a single replacement reaction where one metal replaces the other metal. A single replacement reaction is an oxidation-reduction reaction. In this case the solid metal gets oxidized and the metal ion gets reduced. Predict the products.

**\*Reading Check:** What type of reaction is shown in the example in steps 1-3?

**Your task:**

1. **Using arrows as shown on the next page in the example diagram, show what is** 
   1. **being oxidized**
   2. **being reduced**
   3. **the spectator ion.**



|  |
| --- |
| AgNO3 + Zn **🡪** Zn (NO3)2 + Ag |
| AgNO3 + Cu **🡪** Cu (NO3)2 + Ag |
| AgNO3 + Fe **🡪** Fe (NO3)2 + Ag |
| AgNO3 + Sn **🡪** Sn (NO3)2 + Ag |
| Cu(NO3)2 + Zn **🡪** Zn (NO3)2 + Cu |
| **For the following reactions, determine the products and then write the half reactions to determine which element is oxidized and reduced:**  Cu(NO3)2 + Fe **🡪**  Ions in this reaction:  Fe2+ |
| Cu(NO3)2 + Sn **🡪**  Ions in this reaction:  Sn2+ |
| Al(NO3)3 + Zn **🡪**  Ions in this reaction:  Zn2+ |
| Pb(NO3)2 + B **🡪** |